2-Day Course – Spatial Modeling with Geostatistics

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“In two days, what a geoscientists needs to know about geostatistics, and workflows to get you started with applying geostatistics to impact your work.”

Spatial Modeling with Geostatistics

Prerequisites

Lecture outline . . .

- **Who am I?**
- **Class Objectives**
- **Class Strategy**
- **Essential Pre-work**
  - **Installation, set up**

Prerequisites

Introduction

Probability Theory

Representative Sampling

Spatial Data Analysis

Spatial Estimation

Stochastic Simulation

Uncertainty Management

Machine Learning

Class Description. . .

Who am I?

- new this fall to UT PGE.
- over 17 years of experience in consulting, teaching and industrial R&D in statistical modeling, reservoir modeling and uncertainty characterization.
- associate editor with Computers and Geosciences, nominee to International Assoc. of Mathematical Geosciences committee.
- member of scientific committee for Geostatistical Congress 2016.
- author of the textbook “Geostatistical Reservoir Modeling” and > 40 peer reviewed publications, patents etc.
- “I want to give you a competitive edge in your careers with geostatistics.”

Class Objectives

Teach theory and practical methods for geostatistics.

Communicate:

- the benefits and uses of geostatistics,
- the common spatial and uncertainty modeling workflows,
- how to better integrate their domain knowledge into the geostatistical model.

Provide knowledge and resources to start geoscientists building their own workflows.

Initial experience with workflow construction with open source

Class Strategy

A combination of lecture, demonstration and hands-on

Lectures

- Provide the fundamental theory with a focus on practice

Demonstrations

- Illustrate the use of geostatistics with open source to solve practical problems
- I will use Python / GSLIB, Excel, and R workflows that are available to students

Hands-on

- Experiential learning with R / R Studio and “gstat” package

Hands-On

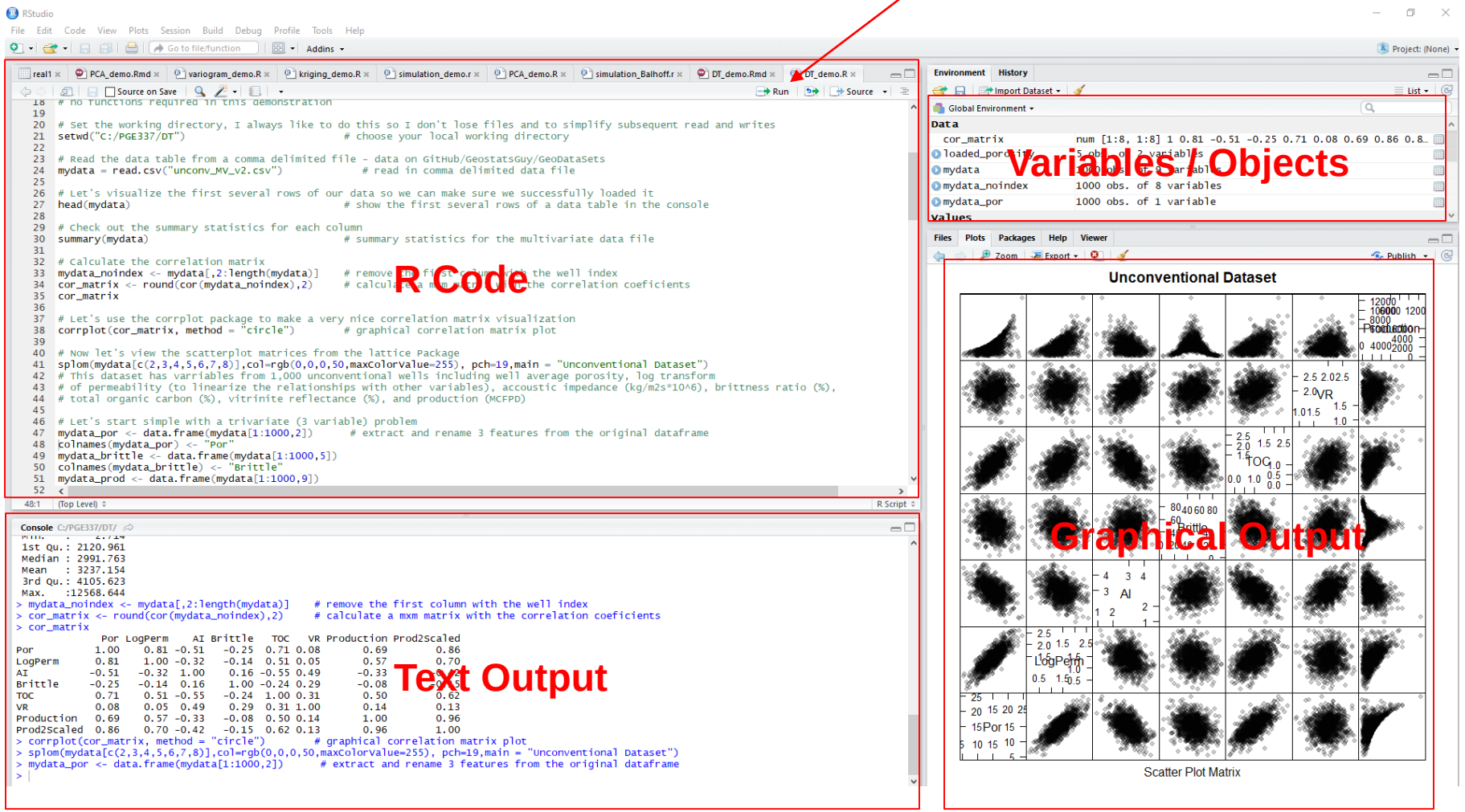
We will conduct hands-on in R, because it is easiest for getting started, and has robust packages for geostatistics and data analytics

It will require students to complete the following before the class.

1. Install R from one of the mirror sites (e.g. http://cran.wustl.edu/)
2. Install R Studio from https://www.rstudio.com/products/rstudio/download/. The free version is fine.

Hands-On

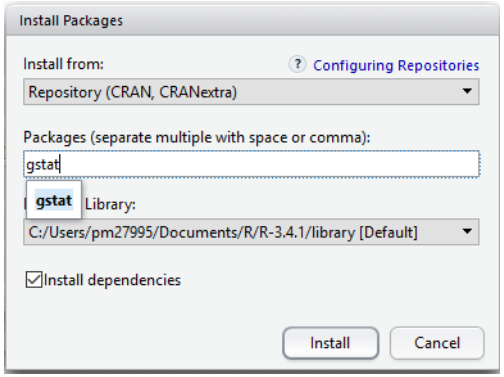
3. Open R Studio



Hands-On

4. Install the following packages
   - gstat geostatistics package by Edzer Pebesma
   - sp adds spatial to DataFrames
   - plyr manipulating data
   - ggplot2 plotting
   - fields plotting regular grid models
   - lattice matrix scatter plots
   - corrplot correlation plots
   - tree decision trees

To install packages go to Tools/ Install Packages…



Enter name of package and select install.

Ignore R Version warnings.

Hands-On

5. Open provided R code, kriging_demo.R
https://github.com/GeostatsGuy/geostatsr/blob/master/kriging_demo.html

6. Change the working directory

```
# Set the working directory, I always like to do this so I don't lose files and to simplify subsequent read and writes
setwd("C:/PGE337")
```

   - Change from C:/PGE337 to a folder of your choice on your computer

7. Download these datasets from GitHub and put them in your working folder.
   - **2D_MV_200Wells.csv**
     - **https://github.com/GeostatsGuy/GeoDataSets/blob/master/2D_MV_200wells.csv**
   - **unconv_MV_v2.csv**
     - **https://github.com/GeostatsGuy/GeoDataSets/blob/master/unconv_MV_v2.csv**
   - **unconv_MV_v3.csv**
     - **https://github.com/GeostatsGuy/GeoDataSets/blob/master/unconv_MV_v3.csv**

Hands-On

8. Back in R Studio window, place the cursor at the top of the code and step through the code with the “run” button indicated on slide 6.
9. Watch the text and graphical output. Check text output for errors. Warnings are fine.
   - A couple of the numerical methods may take 15 to 30 seconds to complete so be patient.
   - Resist the temptation to “machine gun” the run button as this may cause a crash of R studio.
10. If you get to the end of the code file then you should be set up and good-to-go for the hands-on sections.

Hands-On

- If you are not able to complete this set up, then you can pair up with another student to work together on the hands on sections.

What did you just learn?

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